Doing the Math: Calculating a Sustainable Stocking Rate

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Highlights

Although terms such as AUM, stocking rate, and carrying capacity are widely used in range management, there is often confusion as to what they mean. The purpose of this article is to define the terms, give examples of how to calculate them, and provide a worksheet for individuals to practice calculating their own values.

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Introduction

We've all heard the terms AUM, stocking rate, and carrying capacity used by range professionals and ranchers alike, but what do they all mean? Let's define these right now:

AUM or Animal Unit Month = ***The amount of feed required to sustain a 1,000 lb cow and her calf (up to 6 months of age) for one month. (Roughly 800 lbs of oven dry forage)***

Carrying capacity = ***The maximum number of individuals of a given species that a site can support over a certain period of time without causing deterioration of the site. (How many***

animals the forage base is capable of supporting- subject to change due to growing conditions)

Stocking rate = ***The number of animals per unit area over a given period. (How long your animals are out on your pasture)***

AUMs

So, all this theoretical stuff is great, but we're not all scientists, so how about the practicality? Let's start by plugging in some real numbers. First, most producers in the Coteau do not run 1,000 lb cows. They're more like 1,200-1,400 lb cows. So, how do we account for those extra pounds? We use what is called an Animal Unit Equivalent or AUE. Table 1 gives some common AUEs: If the average weight of your cows is 1,284 lbs, the AUE is 1.284 (be honest with yourself!). Which is the same as saying that each one of your cows will eat as much as 1.284 cows. For example, if you had a herd of 100 cows that weighed an average of 1,284 lbs, they would eat as much as 128.4 cows that weigh 1,000 lbs each. (This is our adjusted AU) Which brings us to the next question, just how much does a cow eat anyhow? An average 1,000-lb cow will eat approximately roughly 26.1 lbs of oven dried forage per day or 80% of her body weight per month. So, if your cow weighs 1,284 lbs then, ***1,284 lbs x 0.8 = 1,027.2 lbs*** of feed per month! And that means that our herd of 100 cows eats: ***1,027.2 lbs x 100 cows = 102,720 lbs*** of feed per month.

Table 1. Common animal unit equivalents (AUEs; Pratt and Rasmussen 2001).

Type of Animal	Animal Unit Equivalent	Comments
Cow calf pair (1,000 lb cow)	1.00	*There are different ways of determining the AUEs, including the use of metabolic weights. For more information see: Manske 1998; National Research Council 1996.*
Each additional 100 lbs of cow	0.10	
Bull	1.40	
Steer	0.85	
Heifer	0.80	
	0.20	

Sheep		

CARRYING CAPACITY

Carrying capacity is simply the maximum number of animals a site can support over a given period of time without causing detriment to the future forage production. So how much forage is produced annually? That depends on a number of factors, including precipitation, soils, grazing history, plant community composition, your current management, and so on. You can determine how much your land produces by going out to the pasture and clipping a small area of known size (known as a frame) and then multiplying by the correct factor to determine the pounds per acre. But, if you don't have this information handy, you can use Table 2 below. This information was interpreted from the 1977 publication *North Dakota Rangeland Resources* by Shaver, based on current information. It should be noted that these figures are ESTIMATES and may not represent actual productivity on your land. These numbers should be used with caution and professional assistance, such as that provided by extension agents, can help you to more accurately determine the production on your land. Use Figure 1 to determine which vegetative zone your land is in. If we assume that we have 640 acres in the Central region using Table 2, we can assume the land produces 1,700 pounds of forage per acre annually. This means that the land can produce a total of 1,088,000 lbs of forage annually.

640 acres x 1,700 lbs/acre = 1,088,000 lbs

Table 2. Vegetative zones of North Dakota with estimated production in pounds per acre.

Vegetative Zones	Pounds per acre
Red River	2,700
Altamont	2,100
Border	1,900
Central	1,700
Drift Prairie	1,700
Coteau	1,500
Missouri Slope	1,300
Badlands	1,100

Theoretically, a herd of cows could eat all 1,088,000 lbs of this, but in reality, we know this isn't true. First off, we know that current recommendations are: take half of the forage, leave half.

1,088,000 lbs x 0.5 proper grazing factor = 544,000 lbs

Out of these 544,000 pounds, cattle will only fully utilize about half of that. The other half cattle will trample, bed down in, and urinate and defecate on.

544,000 lbs x 0.5 proper utilization factor = 272,000 lbs

Carrying capacity is typically expressed in AUMs or how many 1,000-lb cows
with a calf could graze for one month (30 days):

$$\frac{272{,}000 \text{ lbs}}{26.1 \text{ lbs} \times 30 \text{ days}} = 347.4 \text{ AUMs}$$

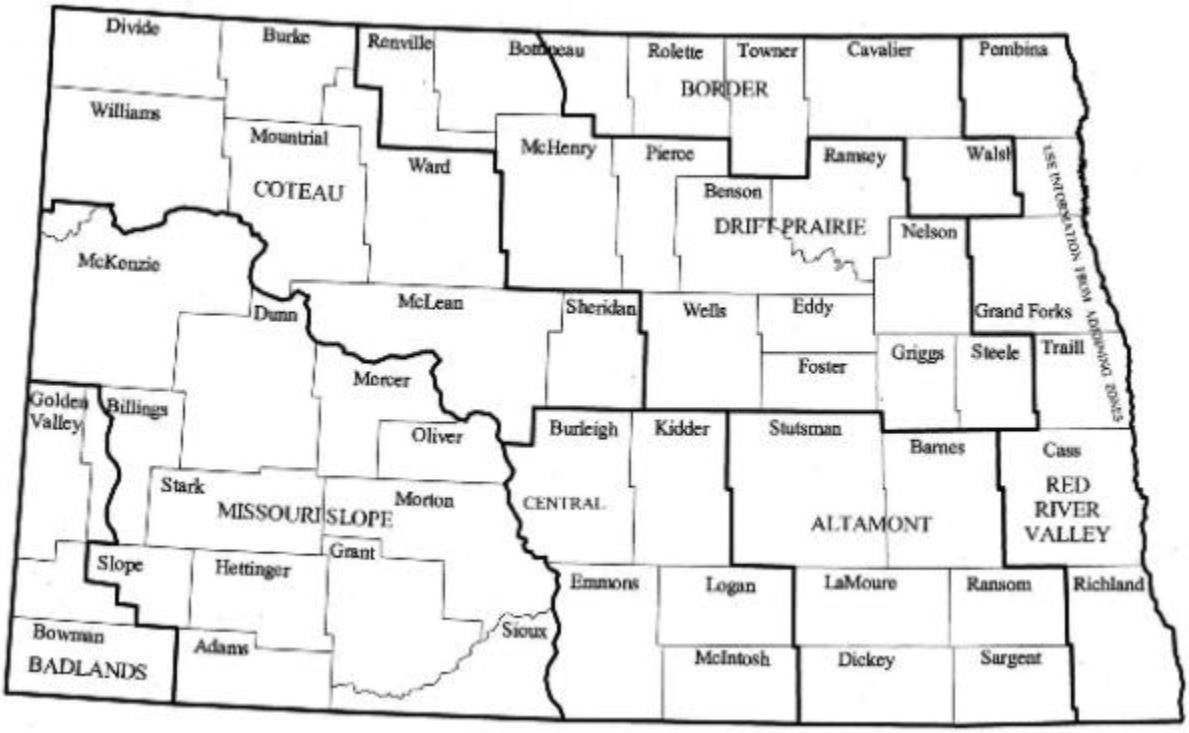

Figure 1. Map depicting the eight vegetative zones in North Dakota (courtesy of NRCS)

STOCKING RATE

There are different ways of expressing stocking rate for a given herd of livestock but the most commonly used are:

$$\left\{\frac{AUMs}{Acre}\right\} \qquad Or \qquad \left\{\frac{Acres}{AUM}\right\}$$

To determine our AUMs, we simply multiply our adjusted AU from above by how many months the animals will be out on pasture. Let's assume we'll keep the herd out on this pasture from May 15 to August 15, three months. From above, we recall that we had 128.4 AUs, so:

128.4 AUs x 3 months = 385.2 AUMs

Note at this point, we have already exceeded our carrying capacity for our 640 acre pasture that produces 1,700 lbs per acre. To calculate stocking rate, all we need is our acres:

$$\frac{385.2\ AUMs}{640\ \ acres} = 0.6\ AUMs\ per\ acre \quad OR \quad \frac{640\ acres}{385.2\ AUMs} = 1.66\ acres\ per\ AUM$$

Pasture stocking rates can vary widely and in past research, values ranged from 1.3-2.0 acres per AUM. Our current recommendation is a conservative value of 1.4 acres per AUM (Nyren et al.1991) in the Central region. The number of acres recommended per AUM would be higher in the drier, less productive parts of the state and lower in the wetter, more productive parts of the state. Also, under less management-intensive scenarios, the acres per AUM could be substantially higher. Conversely, under more intensive management scenarios that provide for more days of recovery during the active growing season, the acres required per AUM could be reduced.

SUSTAINABLE STOCKING RATE

So we know that under the current scenario, we are overstocking our 640 acres. We can reduce our stocking rate a couple of ways; we could increase the number of acres the herd is grazing, we could decrease the number of animals in the herd, or we could reduce the amount of time the herd is out on pasture. Is there a way to find out how long we should keep the herd out on pasture without causing adverse effects? The following is an equation for calculating a sustainable stocking rate, based on the herd that you already currently own:

$$\left\{\frac{\textbf{Lbs per acre x acres}}{\textbf{lbs eaten per month}}\right\}$$

So if we use the numbers we have already assumed; 640 acres and assuming that acreage produces 1,700 lbs per acre we get 1,088,000 lbs of forage produced per year in a normal year (640 x 1,700 = 1,088,000). Keep in mind that this is **total** forage. It doesn't take into account what is palatable or the community composition, and it takes a lot of grass to equal the weight of one buckbrush or western snowberry (*Symphoricarpus occidentalis*) plant. Remember, this is a total, and we need to apply the proper grazing factor of take half, leave half. So, 1,088,000 lbs x 0.5 = 544,000 lbs of forage available for our herd of 100 cows. We also need to take the proper utilization factor of 0.5 as well. So, 544,000 lbs x 0.5 = 272,000 lbs. Remember, our cattle eat 102,720 lbs of feed per month, so if we have 272,000 lbs of forage available ÷ 102,720 lbs the herd eats in a month = 2.65 months. Our section (640 acres) can support our herd of 100 cows for about 2.65 months or about 70 days. Does that seem a little surprising to you?

$$\frac{\textbf{272,000 lbs}}{\textbf{102,720 lbs per month}} = \textbf{2.65 months}$$

WORKSHEETS

Following is a sample worksheet designed to help you determine your stocking rate. This worksheet is designed to give you an approximation of stocking rate, not a "hard, fast" answer. The available forage can and does change rapidly with climatic conditions, such as drought. I would highly recommend seeking professional assistance, particularly with clipping forage samples as different sizes of frames have different conversion factors. Your local soil conservation district office and county extension office are excellent resources.

Sample worksheet

I have **100** cows and they weigh an average of **1,284** lbs

My adjusted animal unit (AU) is **100** cows x **1,284** lbs = **128.4** ***AU***

One of my cows eats 80% of her **1,284** lbs per month
1,284 lbs x **0.8** = **1,027.2** lbs per month

My **100** cows x eat **1,027.2** lbs each per month, so my herd eats **102,720** lbs per month

I have **640** acres of land

My land produces **1,700** lbs of forage per acre (see Table 1)

My land will likely produce **1,088,000** lbs of forage per year
640 acres x **1,700** lbs per acre = **1,088,000** lbs of total forage per year

Proper grazing factor = Take half, leave half = **0.5**

1,088,000 lbs of total forage per year x **0.5** = **544,000** lbs of available forage per year

Proper utilization factor = **0.5**

544,000 lbs x **0.5** = **272,000** lbs of utilizable forage per year

544,000 lbs of utilizable forage per year ÷ (26.1 lbs per day x 30 days) =
347.4 AUMs of ***carrying capacity***

If I leave my herd out to pasture for **3** months

My adjusted AU: **128.4** AU x **3** months = **385.2** ***AUMs***

My ***stocking rate*** is **385.2** AUMs ÷ **640** acres = **0.6** AUMs per acre

OR: My ***stocking rate*** is **640** acres ÷ **385.2** AUMs = **1.66** acres per AUM

My land can support my **100** cows for **2.65** months (utilizable lbs forage ÷
lbs of feed consumed per month) **272,000** ÷ **102,720** = **2.65** months
Sustainable Stocking Rate

Worksheet for Producer Use

I have _____cows and they weigh an average of _____ lbs

My adjusted animal unit (AU) is _____ cows x _____ lbs = _____ ***AU***

One of my cows eats 80% of her _____lbs per month
_____ lbs x **0.8** = _____lbs per month

My _____ cows x eat _____ lbs each per month, so my herd eats _____
per month

I have_____ acres of land

My land produces_____ lbs of forage per acre (see Table 1)

My land will likely produce _____ lbs of forage per year
_____ acres x _____ lbs per acre = _____ lbs of total forage per
year

Proper grazing factor = Take half, leave half = **0.5**

_____ lbs of total forage per year x **0.5** = lbs of available forage per year

Proper utilization factor = **0.5**

_____ lbs x **0.5** = _____ lbs of utilizable forage per year

_____ lbs of utilizable forage per year ÷ (26.1 lbs per day x 30 days) =
_____ AUMs of ***carrying capacity***

If I leave my herd out to pasture for _____months

My adjusted AU: _____AU x_____ months = _____ ***AUMs***

My ***stocking rate*** is_____ AUMs ÷_____ acres = _____AUMs per acre

OR: My ***stocking rate*** is _____acres ÷ _____AUMs = _____acres per AUM

My land can support my _____cows for _____ months (utilizable lbs forage ÷
lbs of feed consumed per month)
_____÷_____=_____ months
Sustainable Stocking Rate
